Advanced Smart Mobile Monitoring Solution for Managing Efficiently Gas Facilities of Korea

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Abstract. Remote monitoring and control system using Wireless communication have been developed to improve the efficiency of management solution for industrial facilities. However, those systems might be decreasing the efficiency and convenience because of connecting portable device using wired cable (RS232C or USB). This study is intended to design and develop a mobile smart city gas safety management system in order to solve inefficiency and inconvenience of wireless smart city gas safety management system. The mobile system is to be designed to be applicable to major city gas supply facilities and to provide augmented reality-based facility information in order to improve usability and practicality. Accordingly, this system is being implemented to be usable on diverse smart devices and is expected to bring about management efficiency with its strength and mobility.

Keywords: Mobile Monitoring Solution, Safety Management, AR

1 Introduction

Until recently, risk factors in city gas supply facilities such as pressure and temperatures have been manually measured and identified, but now the method of measurement is evolving into remote monitoring systems using wire communications [1, 4]. Furthermore, wireless remote monitoring systems and control systems have been developed to improve the efficiency of the management of domestic and foreign industrial facilities [5, 6, 7].

In a preceding studies, we established a wireless smart city gas safety management system to measure parameters that are not monitored through previous wired systems [2,3]. Nevertheless, improvement was necessary because efficiency and convenience had decreased since inspectors in the city gas site facility needed to connect an RS232C or USB, etc. to a PDA or notebook for immediate data checking during moving or patrolling. In combination with the foregoing system, in diverse gas-related facilities, efforts are in progress to enhance users' convenience and management efficiency by providing services on mobile devices.

The purpose of this study is to design and develop a mobile smart city gas safety management system in order to solve inefficiency and inconvenience of the wireless

smart city gas safety management systems. The mobile smart safety management system has been designed to be applicable to major city gas supply facilities. In particular, we improved its usability and practicality by providing augmented reality-based facility information and reinforced its security by encoding interlocking between the system and mobile devices. To be usable on other types of smart devices, we implemented the proposed safety management system using Object-C and Java and developed it to enable users to explore facilities and present detailed information in diverse modes based on a number of viewpoints.

2 Augmented reality-based Mobile Monitoring System design

This study aims to develop an augmented reality-based mobile city gas supply facilities' safety management system interlocked with already established intelligent safety management systems. To this end, first, the functions necessary to compose a mobile system for city gas supply facilities' safety management will be defined and then the method in which the augmented reality-based system will functions through interlocking between intelligent safety management systems and mobile services will be identified.

AR is a way viewing a physical, real-world environment whose elements are augmented by computer-generated sensory input (e.g., sound, video, graphics or GPS data) to enhance the perception of the real world. The advancement of IT technology today along with the widespread use of smartphones has created the ideal computing environment for the application of AR technologies. AR applications are categorized according to the purpose of use and the platform. Currently, AR is exploited in a variety of domains such as travel, shopping, publication, education, game and healthcare.

Layar, a leading mobile AR company, released AR-enabled Android navigation apps in June 2009 and distributed its technology on iPhones (i.e., iOS platforms) in October 2010. Mobnotes and Peaks are representative examples of AR apps. Mobnotes on iPhones provides a user-driven guide to local interesting places and events and shares this information with friends via social networking services (SNS). The Peaks app discovers the mountains and hills around the users from an arbitrary location of their choice. These applications make use of the AR technology to display real-time digital information on top of reality in the camera screen of the user's mobile phone. They also include various additional features (e.g., SNS) that correspond to mobile apps market trends.

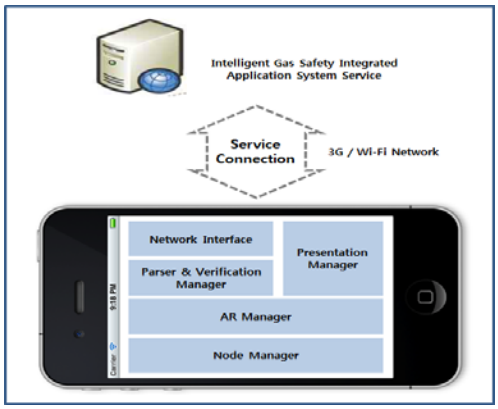

Fig. 1. Mobile system architecture

Fig. 1 is a schematization of a component block diagram of the mobile system for city gas supply facilities' safety management to be implemented in this study. The system was differentiated from existing safety management systems utilizing wire Internet networks by utilizing the 3G/Wi-Fi Network to secure the mobility of the vsafety management system. Through this, the system was designed to solve the problem of interlocking with already established intelligent safety management systems.

The system to be implemented in this study consists of a Network Interface, a Data Parser & Verification Manager, a Presentation Manager, an AR Manager, and a Node Manager. The Network Interface provides wireless communication interfaces linked with intelligent city gas safety management systems. The Data Parser & Verification Manager is a module to analyze packet data transmitted to/received from intelligent city gas safety management systems and verify facility nodes. The Presentation Manager is a module to present facility condition information and show actual image screens of facility nodes through linkage with the augmented reality manager. The AR Manager is a module to display node location information on the screen and provide detailed node information through linkage with sensor monitoring provided by devices, API abstracts, and the Presentation Manager. The Node Manager serves functions as a module to manage Meta information of individual facilities, update node information, and manage node generation cycles and security.

3 Advanced Mobile Monitoring Solution for Gas Facilities

The mobile safety management provides six functions: facility finding, abnormal facilities, interesting facilities, facility registration, environment setting, and help functions. In particular, the facility finding function provides three view options: a camera mode, a list mode, and a map mode.

Firstly, the camera mode shows facility node information on actual camera screenshots built into smart devices. This is the realization of augmented reality technologies. In the camera mode, actual facilities existing at the side of the camera

and the sizes of node icons are differently seen depending on the perspective, as shown in Fig. 5. If the facility node icon is displayed on the actual screenshot, summarized facility information will be shown. The summarized information shows the types, IDs, and names of facilities and provides a touch text to convert the screen into 'View details.' If the user selects 'View details,' detailed information on the gas valve room, test box, and exposed piping, etc. will be displayed as shown in Fig. 6.

Fig. 5. Facility search using camera mode

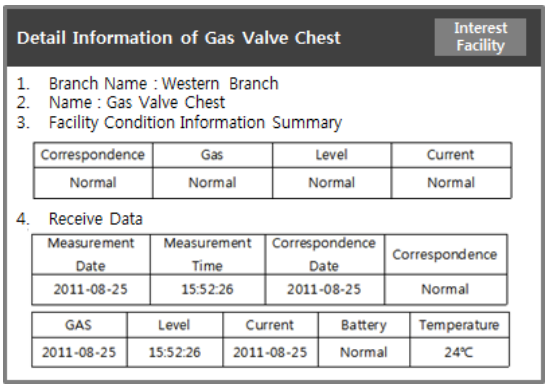

Fig. 6. The detail information layout

Secondly, the list mode shows facility information clearly in tables. The list mode shows information on facility types, facility IDs, facility names, locations, and conditions as shown in Fig. 7. The location information indicates how far the facilities are from the user based on the current user location information. The condition information indicates whether the facility conditions are normal or not, and, if there is any abnormality, this information will be highlighted. Facility nodes are determined based on location information and detailed information appears when the relevant facility column has been touched.

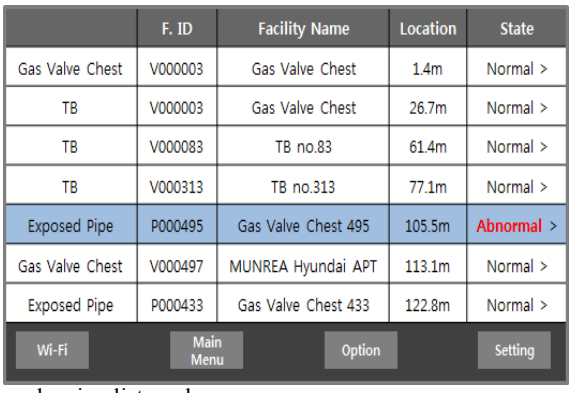

Fig. 7. Facility search using list mode

Finally, the map mode indicates facility information on the map using pins. This mode has an advantage in that it enables users to grasp information on the facilities' relative locations relatively easily. This mode indicates facility information using green pins and red pins based on information on the current user location. Green pins mean facilities showing normal condition information and red pins mean facilities showing abnormal condition information. By touching the pins, detailed information on facilities can be seen as shown in Fig. 8.

Fig. 8. Facillity search using map mode

4 Conclusion

This paper describes a mobile smart city gas safety management system that is efficient in site management and improves user convenience and is designed and developed by expanding wireless smart city gas safety management systems. The mobile smart city gas safety management system was designed based on the augmented reality technique to have five core modules: a Network Interface, a Data Parser & Verification Manager, a Presentation Manager, an AR Manager, and a Node Manager. In particular, the augmented reality (AR) manager was implemented to

obtain actual screenshots, detect movements, and obtain location information in linkage with the camera, gravity sensor, and GPS to present facility node information on actual camera screenshots.

The mobile safety management provides six functions: facility finding, abnormal facilities, interesting facilities, facility registration, environment setting, and help functions. In particular, the facility finding function provides three view options: a camera mode, a list mode, and a map mode. The camera mode was implemented to show facility information using actual screenshots and the list mode was implemented to make lists of facility information in order to show basic facility information. The map mode was implemented to indicate facility information on maps so that information on facilities' relative locations can be easily grasped. As a future plan, experimental studies will be conducted to improve the developed mobile system's sustained safety and reliability.

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References

1. Krco, S. Tsiatis, V. and Matusikova, K.: Moblie Network Supported Wireless Sensor Network Services. In: the IEEE International Conference on Mobile Adhoc and Sensor System, pp.1--3 . (2007)
2. Oh, J. S., Park, J. S. and Kown, J. R.: Selecting the Wireless Communication Methods for Establishing Ubiquitous City-Gas Facilities in Korea. Lecture Notes in Computer Science, 5576,. 823--828 (2009)
3. Oh, J. S., Bang, H. J. and Ko, H.: An Empirical Study on Smart Safety Management Architecture for Gas Facilities in Korea. Information, 15(3), 1107--1122 (2011)
4. Wang, H., Zhang, Y. and Cao., J.: Ubiquitous Computing Environments and Its Usage Access Control. In: the International Conference on Scalable Information System, pp.1--10. (2006)
5. Stioanov, I., Nachman, L., Madden, S., Tokmouline, T. and Csail, M.: PIPENET: A Wireless Sensor Network for Pipeline Monitoring. In the 6th International Symposium on Information Processing in Sensor Networks, pp. 264--273. Cambridge (2007)
6. NETL, Oil and Natural Gas Projects (Transmission, Distribution, and Refining), http://www.netl.doe.gov
7. Honywell Process Solutions: oneWirelessNetwork, http://hpsweb.honywell.com/Cultures/en-US/Products/Wireless/SecondGenetrationWireless/default.htm